

A Supplementary list of the Host-Plants of lac Insects

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INTRODUCTION

Lac insects, specially of the Genus *Laccifer*³ because of their great economic importance, have attracted naturalists from time to time to collect information about their host-plants, both by field surveys or experiment and from scattered literature. Attempts in this direction were first made in 1901 by Sir George Watt, who listed 56 such plants. Roonwal *et al.* (1958) listed 14 common, 14 occasional, and 85 rare (total 113) host-plants of the lac insect, *Laccifer lacca* (Kerr) and its closest allies in the Indian Region, comprising India, Pakistan, and Burma. Roonwal & Singh (1958) added a 'supplementary list' by listing 79 more names of host-plants, without going through their present nomenclative position.

Since then, many workers including those of the Entomology Division, Indian Lac Research Institute, Ranchi, have reported a number of new lac host-plants. A thorough review of the literature on lac and lac insects has also revealed several lac-hosts occurring all over the world. The junior author during his visit to Thailand in July 1963, also collected information on lac-hosts in that country through the courtesy of the Royal Forest Department and Department of Agriculture, Thailand. The present list gives an account of all such host-plants together with names which have not been mentioned by Roonwal *et al.* (1958) and Roonwal & Singh (1958).

As the identity of some species of lac insects is still doubtful, the names of the lac insect species have been mentioned in the accompanying list as per source. Nomenclature of the host-plants, their author's name

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³ A recent study (*Indian J. Ent.* **28**: 116-118, 1966) by the senior author of this work has revealed that the generic name, *Laccifer* Oken, 1815, is invalid and should be substituted by generic name *Kerria* Targ., 1884. The International Commission on Zoological Nomenclature has looked into the case and confirmed this change.

and family, though mostly based on original description, have been brought up-to-date by consulting INDEX KEWENSIS and its supplements, WEALTH OF INDIA, SIAMESE PLANT NAMES, Willis's DICTIONARY OF FLOWERING PLANTS AND FERNS, Bailey's MANUAL OF CULTIVATED PLANTS, and Raizada (1958). Some plant names, whose scientific position could not be determined from these references, were sent for verification to the Royal Botanic Gardens, Kew, Surrey. The report sent by the Director has been given in full, with the lac-hosts concerned, in the list. The classification of the host-plants in different categories according to their importance in lac cultivation forms a subject matter for further study. The present list is intended to assemble in one place the much scattered information about the lac-hosts already recorded in different parts of the world, for ready reference by research workers engaged in the task of selecting potentially useful lac-hosts for their regions.

ALPHABETICALLY ARRANGED LIST OF LAC-HOSTS

The available information in respect of each host-plant has been presented in the following order :

Serial No. ; scientific name of the plant and author of the plant species as given originally ; present nomenclative position of the host-plant if it has changed ; family or natural order of plant ; synonyms of the plant ; notes on availability of lac ; species of the lac insect and country where it has been observed ; sources of the information with year and page number of the references.

Sharapov & Prokopenko (1960) have given a list of host-plants under the title 'List of plants growing lac insects, distributed in India, Burma, Ceylon, China and Thailand.' For convenience these countries have been substituted by 'Oriental region' in the present list.

1. *Acacia* sp. (Leguminosae). *Laccifer lacca* (Kerr) feeds on sap (Bhasin & Roonwal 1954, p. 27).
2. *A. cavenia* Bertol. ex Bull. (Leguminosae). Host-plant of *Laccifer mysorensis* in India (Kapur 1958, p. 22).
3. *A. chundra* (Roxb.) Willd. (Leguminosae). Syn. *A. sundra* DC. *Laccifer lacca* and *L. mysorensis* have been observed on this plant in Indian region (Kapur 1958, pp. 20 & 22).
4. *A. confusa* Merrill (Leguminosae). Food plant of the lac insect in Siam and Formosa (Takahashi 1949, p. 25).
5. *A. dealbata* Link (Leguminosae). *Laccifer lacca* and *L. sindica* are reported on it from the Oriental region and Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 18 & 30).

6. **A. decurrens** Willd. (Leguminosae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
7. **A. donaldii** Haines (Leguminosae). Regional host tried for lac cultivation at Damoh, India (I.L.R.I. Ann. Rep. for 1962-63, p. 17).
8. **A. intsia** Willd. (= *A. caesia* Willd.) (Leguminosae). Possible important host for lac utilization in south Madras and wherever gregarious in India (Negi 1956, p. 47). Lac is commonly seen on it at Travancore, India (Barker 1921).
9. **A. rugata** Buch.-Ham. (Leguminosae). Host-plant of *L. lacca* (Kapur 1958, p. 20, mentioned it as synonym of *A. concinna* DC.).
10. **A. torta** (Roxb.) Craib (Leguminosae). Unsatisfactory host of lac (Thakur 1932, p. 3). Host-plant of *L. communis* reported from India (Kapur 1958, p. 16).
11. **Acer laevigatum** Wall. (Aceraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
12. **Ailanthus fauveliana** Pierre (Simaroubaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
13. **Albizia** sp. (Leguminosae). Food plant of the lac insect in Formosa. On the stem of a young tree at Taihoku, Formosa, mortality of the lac insect larvae was more on the lower part than on the upper part (Takahashi 1949, pp. 23, 31). *L. lacca* (Kerr) and *L. albizziae* (Green) feed on its sap (Bhasin & Roonwal 1954, pp. 54-55).
14. **A. julibrissin** Durazz. (Leguminosae). Lac-host in Georgia, U.S.S.R. Experiments of lac culture are also running on this plant in Russia, since 1958 (Sharapov & Prokopenko 1960, p. 30 and Fig. 22).
15. **A. kalkora** (Roxb.) Prain (Leguminosae). *L. lacca* and *L. sindica* are reported on it from the Oriental region (Sharapov & Prokopenko 1960, p. 18).
16. **A. marginata** Buch.-Ham. (Leguminosae). Host-plant of *L. lacca* (Kapur 1958, p. 20 mentioned it as synonym of *A. stipulata* Boivin).

17. **A. richardiana** King & Prain (Leguminosae). Good encrustation of *Rangeeni* strain of *L. lacca* was observed on this plant at Calcutta, India, during 1961-62 (Srivastava, Rao & Varshney 1964, pp. 104-105). Also in 1962 at Indian Botanic Gardens, Calcutta (Mukhopadhyay 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702-703).
18. **Aleurites fordii** Hemsl. (Euphorbiaceae). Classified as bad host of lac on the basis of its pH value range (Thakur 1932, p. 3).
19. **A. triloba** Forst. (Euphorbiaceae). Syn. *A. moluccana* Willd. Lac-host recorded from Punjab, India (Watt 1901, p. 210 ; Roonwal & Singh 1958, p. 134 ; Malhotra 1964, p. 368, synonymy given).
20. **Amherstia nobilis** Wall. (Leguminosae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413 ; Chamberlin 1923, p. 166 ; Bhasin & Roonwal 1954, p. 65 ; Sharapov & Prokopenko 1960, p. 18 ; Gupta 1962, p. 114). Also of *L. communis* in India (Kapur 1958, p. 14). It carried excellent *Rangeeni* strain of *L. lacca* at Calcutta, India (Mukhopadhyay 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702, 703).
21. **Annona cherimolia** Mill. (Annonaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
22. **A. muricata** Linn. (Annonaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16) and of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 18).
23. **A. palustris** Linn. (Annonaceae). Host of *T. conchiferata* in Ceylon (Green 1922, p. 408 ; Chamberlin 1923, p. 172 ; Gupta 1962, p. 114). Also host of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 19). Host of *L. communis* in India (Kapur 1958, p. 16).
24. **Aralia cordata** Thunb. (Araliaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
25. **A. vitthii** T. Moore (= *Dizygotheca veitchii* N. Taylor) (Araliaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
26. **Averrhoa carambola** Linn. (Oxalidaceae). Host of *Laccifer* sp. and *L. greeni* in Formosa (Takahashi 1928a, p. 347 ; 1928b, p. 261 ; 1929, pp. 7 & 69).
27. **Bischofia trifoliata** (Roxb.) Hook. (= *Bischofia javanica* Bl.) (Euphorbiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

28. **Bombax malabaricum** DC. (= *Bombax ceiba* Linn., (Bombacaceae). A minor lac-host in Punjab, India (Anand 1936, p. 9; Malhotra 1964, pp. 367-368).
29. **Buchanania lanzan** Spreng. (Anacardiaceae). Syn. *B. latifolia* Roxb. Host-plant of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 19). Lac infection was observed at Taimara, Ranchi Forest Division, India (Purkayastha & Krishnaswami 1961, p. 152; Mukhopadhyay 1962, p. 328).
30. **B. lucida** Blume (Anacardiaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to the junior author by the Royal Forest Department, Thailand).
31. **Caesalpinia** sp. (Leguminosae). *L. lacca* feeds on the sap of this host in the Oriental region (Sharapov & Prokopenko 1960, p. 18; Bhasin, Roonwal & Singh 1958, p. 51).
32. **C. digyna** Rottl. (Leguminosae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
33. **C. sappan** Linn. (Leguminosae). Host-plant of *L. communis* reported from India (Kapur 1958, p. 16).
34. **Calliandra haematocephala** Hassk. (Leguminosae). Host of *Laccifer* sp. and *L. greeni* in Formosa (Takahashi 1928a, p. 347; 1928b, p. 261; 1929, pp. 9 & 69).
35. **Carissa opaca** Stapf. (Apocynaceae). Lac-host recorded exclusively from Punjab, India. (Malhotra 1964, p. 369, synonymy given). However, this is not given as food plant of lac insect by Stebbing (1910), as has been shown by Malhotra (loc. cit.).
36. **Carya olivaeformis** Nutt. (= *C. illinoensis* Koch) (Juglandaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
37. **Cassia** sp. (Leguminosae). *L. lacca* feeds on its sap (Bhasin, Roonwal & Singh 1958, p. 90).
38. **C. surattensis** Burm. f. (Leguminosae). Syn. *C. glauca* Lam. Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).
39. **Castanopsis** sp. (Fagaceae). *Laccifer lacca* observed on it in Indian region (Kapur 1958, p. 20).

40. **Casuarina equisetifolia** Forst. (Casuarinaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16). Host on which lac insect cannot maintain itself due to insufficient bio-chemical factors (Sreenivasaya 1924, pp. 120, 124 & 125). Besides this, Sreenivasaya (1924) has classified two more hosts on which lac insect cannot maintain itself. They are *Dodonaea viscosa* (Linn.) Jacq. (Sapindaceae) and *Lantana camara* Linn. (Verbenaceae).
41. **Catha edulis** Forsk. (Celastraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
42. **Celtis cinnamomea** Lindl. (Ulmaceae). Syn. *C. roxburghii* Bedd. Lac-host recorded from Punjab, India. [Watt 1901, p. 211; Malhotra 1964, p. 369, synonymy given. Bhasin, Roonwal & Singh (1958) and WEALTH OF INDIA treat *C. roxburghii* Planch as synonym of *C. tetrandra* Roxb.].
43. **Charoetengia** sp. Lac grown on it at Assam, India (Stebbing 1910, p. 76). Director, Royal Botanic Gardens, Kew, states that this plant name could not be identified.
44. **Citrus** sp. (Rutaceae). Host of *Laccifer* sp. in Formosa (Takahashi 1928a, p. 347; 1929, pp. 11 & 70).
45. **C. maxima** (Burm.) Merrill (Rutaceae). Bugs of *L. lacca* Kerr are pests and suck fruits of this plant (Mathur, Singh & Lal 1958, pp. 28 & 98, mention *C. grandis* Osbeck, and *C. decumana* Linn. as synonyms).
46. **Codiaeum variegatum** Blume (Euphorbiaceae). *L. albizziae* feeds on its sap (Mathur & Singh 1960a, p. 12).
47. **Cola acuminata** Schott et Endl. (Sterculiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
48. **Combretum quadrangulare** Kurz. (Combretaceae). Lac-host in Thailand (Samapudhhi 1957, p. 30; also according to information provided to junior author by the Royal Forest Department, Thailand). One of the chief lac-hosts of Siam (Gupta 1962, p. 127).
49. **C. quadrangulare** Kurz. var. **lanceolatum** (Combretaceae). Host of *L. chinensis*, reported from India, Indo-China, and Siam (Kapur 1958, p. 15).

50. **Commiphora caudatum** W. & A. (= *Commophora caudata* Engl.) (Burseraceae). Host-plant of *L. communis* in India [Kapur 1958, p. 16, written as '*Commiphora (Protium) caudatum* W. & A.'].
51. **Connarus paniculatus** Roxb. (Connaraceae). Lac-host in Burma (Gupta 1962, p. 135).
52. **Corylus** sp. (Betulaceae). Prof. E. V. Borkhsenius reported it as host-plant of lac in U.S.S.R., while giving a talk at Indian Lac Research Institute, Ranchi, on 17-2-1964 on 'Works carried out on lac insect in the Soviet Union'.
53. **C. maxima** Mill. (Betulaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
54. **Croton** sp. (Euphorbiaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
55. **C. argyratus** Blume (Euphorbiaceae). Reported as lac-host from Thailand (Samapuddhi 1957, p. 30).
56. **C. caudatus** Geisel. (Euphorbiaceae). Host of *T. albizziae* in India (Green 1922, p. 413 ; Kapur 1958, p. 14 ; Sharapov & Prokopenko 1960, p. 20 ; Mathur & Singh 1960a, p. 34).
57. **C. lacciferus** Linn. (Euphorbiaceae). Host of *T. conchiferata* and *T. albizziae* in Ceylon (Green 1922, pp. 408 & 413 ; Kapur 1958, p. 14, mentions it as synonym of *C. aromaticus* Linn. ; Sharapov & Prokopenko 1960, p. 20 ; Gupta 1962, p. 114).
58. **Cynometra polyandra** Roxb. (Leguminosae). Excellent *Rangeni* lac crop was observed on it at Calcutta, India (Mukhopadhyay 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702-703).
59. **Daemonorops draco** Blume (Palmaceae). A climbing jungle palm. Dragon's blood (mistaken for lac) is taken from it in China (Mahdihassan 1954, p. 319). In our view this is a doubtful record of a lac-host.
60. **Dalbergia** sp. (Leguminosae). A creeper and rare lac-host in Burma; common in Shan Plateau and near Inle Lake (Watt 1901, p. 90 ; Norris 1931, pp. 13 & 18). Roonwal *et al.* (1958) have reported many species of *Dalbergia* as lac-host, but have given their habit as moderate-sized to large deciduous trees.

61. **D. arborea** Willd. (Leguminosae). Host of *L. lacca* in the Oriental region [Sharapov & Prokopenko 1960, p. 18, mentioned it as synonym of *Pongamia glabra* Vent. (= *Pongamia pinnata* Pierre)].
62. **D. cochinchinensis** Pierre (Leguminosae). Lac-host in Thailand (Samapuddhi 1957, p. 30 ; also according to information provided to junior author by the Royal Forest Department, Thailand). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 15).
63. **D. eupeaux** var. **laccifera** Eberhardt & Dubard (Leguminosae). Host-plant of *Coccus lacca* in Indo-China. One of the hosts found by Crevost, and reported as 'Co-Khet' (Hautefeuille 1924, p. 15). Regarding this plant's name the Director, Royal Botanic Gardens, Kew, writes : ' This name, nor anything like it, traced in *Dalbergia* '.
64. **D. hupeana** Hance (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).
65. **D. hupeana** var. **laccifera** Eberhardt & Dubard (Leguminosae). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 15).
66. **D. kerrii** Craib (Leguminosae). Host of *L. chinensis* reported from India, Indo-China, and Siam (Kapur 1958, p. 15).
67. **D. nigrescens** Kurz. (Leguminosae). Host of *L. chinensis* reported from India, Indo-China, and Thailand (Kapur 1958, p. 15 ; also according to information provided to junior author by the Royal Forest Department, Thailand).
68. **D. szemaoensis** Prain (Leguminosae). Host of lac insect in Yunnan, China. (Chung-lo 1957, p. 86 ; Gupta 1962, p. 120 ; and Roonwal 1962, p. 36). Host of *L. lacca* in Oriental region (Sharapov & Prokopenko 1960, p. 18). Director, Royal Botanic Gardens, Kew, has checked the identity of this plant species.
69. **D. tamarindifolia** Roxb. [= *D. pinnata* (Lour.) Prain] (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).
70. **D. yunanensis** Franch. (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).

71. **Delonix regia** (Boj.) Raffin. (Leguminosae). Syn. *Poinciana regia* Bojer ex Hook. Host-plant of *L. communis* in India (Kapur 1958, p. 16). Host on which the lac insect maintains itself but does not grow (Sreenivasaya 1924, pp. 120, 124 & 125).
72. **Derris robusta** Benth. (Leguminosae). Lac host in Burma (Gupta 1962, p. 135).
73. **Desmodium** sp. (Leguminosae). Food plant of the lac insect in Siam (Takahashi 1949, p. 23).
74. **D. gyrans** DC. [= *D. motorium* (Houtt.) Merrill] (Leguminosae). Host-plant of *L. mysorensis* in India (Kapur 1958, p. 22).
75. **D. oldhami** Oliver (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).
76. **D. purpureum** Fawc. et Rendle. (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960 p. 18).
77. **D. triflorum** (Linn.) DC. (Leguminosae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 18).
78. **Dillenia pentagyna** Roxb. (Dilleniaceae). Lac encrustation was found on it at Taimara, Ranchi Forest Division, India (Purkayastha & Krishnaswami 1961, p. 152; Mukhopadhyay 1962, p. 329).
79. **Diospyros** sp. (Ebenaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
80. **D. kaki** Linn. f. (Ebenaceae). Host of *L. lacca* in the Oriental region and Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 20 & 30).
81. **D. lotus** Linn. (Ebenaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
82. **D. melanoxyton** Roxb. (Ebenaceae). Syn. *D. tupru* Buch.-Ham. Host-plant of *L. mysorensis* in India (Kapur 1958, p. 22) and of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20). Small colonies of lac insects with good development were met on '*D. tupra*' at Dursanipalya, India (Mahdihassan 1923, p. 64).
83. **D. tomentosus** Roxb. (= *D. exsculpta* Buch.-Ham.) (Ebenaceae). *Rangeeni* lac was observed to reach maturity on this plant in

both crops of 1962 at Kundri Forest, Bihar, India (Malhotra & Kulkarni 1964, p. 119).

84. **Dipterocarpus** sp. (Dipterocarpaceae). *L. lacca* feeds on its sap (Mathur & Singh 1960b, p. 53).
85. **D. alatus** Roxb. (Dipterocarpaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
86. **Dolichandrone spathacea** K. Schum. (Bignoniaceae). *L. lacca* has been reported on it in the Indian region (Kapur 1958, p. 19).
87. **Engelhardtia chrysolepis** Hance (Juglandaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
88. **E. colebrookiana** Lindl. (Juglandaceae). Lac-host of secondary importance in Yunnan, China (Chung-lo 1957, p. 87; Gupta 1962, p. 120; and Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
89. **Eriolaena malvacea** (Leveille) Hand.-Mazz. (Sterculiaceae). Second favoured host of lac insect in Yunnan, China. Importance assumed by this plant species as a lac-host in Yunnan is in striking contrast with the Indian list of host-plants (Chung-lo 1957, p. 87; Gupta 1962, p. 120; Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20, mentioned *E. szemaoensis* Hu. as synonym).
90. **E. spectabilis** Planch. (Sterculiaceae). Lac-host in Burma (Gupta 1962, p. 135).
91. **Erythrina variegata** Linn. [var. *orientalis* (Linn.) Merrill: present authors] (Leguminosae). Syn. *E. indica* Lam. Lac-host recorded from Punjab, India (Watt 1901, p. 211; Malhotra 1964, p. 369, synonymy given).
92. **Eugenia** sp. (Myrtaceae). Lac insect has been found on this plant, locally called as 'Thabyegy', in Burma, in between Kalat and Saitepha Hills (Watt 1901, p. 89).
93. **E. dalbergioides** Duth. (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
94. **E. jambolana** Lam. (= *Syzygium cumini* Skeels) (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).

95. **E. jambos** Linn. [= *Syzygium jambos* (Linn.) Alston] (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
96. **E. michelii** Lam. (Myrtaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
97. **Euphoria longan** Steud. (Sapindaceae). Syns. *E. longana* Lam. and *Nephelium longana* Cambess. Host of *L. greeni* in Formosa (Takahashi 1928b, p. 261 ; 1929, pp. 14 & 69). Food plant of lac insect in Siam (Takahashi 1949, p. 24). Suitable lac-host in Taiwan, Formosa Islands, China (Chung-lo 1957, p. 87 ; Gupta 1962, p. 118 ; Roonwal 1962, p. 37). Sharapov & Prokopenko (1960) record *N. longana* as host of *L. lacca* in the Oriental region.
98. **Excoecaria agallocha** Linn. (Euphorbiaceae). Host of *T. conchiferata* in Ceylon (Green 1922, p. 408 ; Chamberlin 1923, p. 172 ; Mathur & Singh 1960b, p. 115 ; Gupta 1962, p. 114). Also host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
99. **Feijoa sellowiana** Berg. (Myrtaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
100. **Ficus** sp. (Moraceae). Type host of *Laccifer javanus*. Locality—Buitenzorg : Java (Chamberlin 1925, p. 34 ; Takahashi 1949, p. 24 ; and Kapur 1958, p. 18). *L. fici* and *L. lacca* feed on the sap of its twigs, shoots, and branches (Mathur & Singh 1960b, p. 150).
101. **F. albipila** King (Moraceae). Host of *Laccifer chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
102. **F. alternans** Wall. (Moraceae). Host of *L. lacca* in the Oriental region (Kapur 1955, p. 158 ; Sharapov & Prokopenko 1960, p. 17).
103. **F. drupacea** Thunb. (Moraceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
104. **F. erecta** Thunb. (Moraceae). A probable food plant of lac insect in Formosa (Takahashi 1949, p. 70).
105. **F. geniculata** Kurz. (Moraceae). Excellent *Rangeeni* lac crop was found on it at Calcutta, India (Mukhopadhyay, 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702-703).

106. **F. gibbosa** Blume (Moraceae). Host-plant of lac insect in Yunnan, China (Chung-lo 1957, p. 86 ; Gupta 1962, p. 120 ; and Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 17).
107. **F. krishnae** C.DC. (Moraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 17). Mahdihassan (1936) artificially inoculated *L. mysorensis* on *F. benghalensis* var. *krishnae* at Bangalore, India (Kapur 1955, p. 160).
108. **F. mysorensis** Heyne ex Roth [= *F. drupacea* Thunb. var. *pubescens* (Roth)] (Moraceae). Host of *L. communis* at Mysore, India (Mahdihassan 1923, p. 98 ; 1948, p. 162 ; and Kapur 1958, p. 17 as synonym of *F. cotoneaeifolia*). Host which promotes the maintenance and growth of the lac insect, but does not induce secretion of appreciable quantities of resin (Sreenivasaya 1924, pp. 120, 124 & 125). Host of *L. lacca* in the Oriental region (Mathur & Singh 1960b, p. 132 ; Sharapov & Prokopenko 1960, p. 17).
109. **F. pilosa** Reinw. (Moraceae). Host of *Laccifer chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16).
110. **F. polysyce** Ridl. (Moraceae). *L. javanus* was discovered on this plant in Malaya. Attempts to propagate lac on it were also made (Miller 1933, pp. 1, 15 & 16 ; Gupta 1962, p. 115).
111. **F. rubiginosa** Desf. (Moraceae). Host of *L. communis* and *L. lacca* in the Oriental region ; also lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 17 & 30).
112. **F. ulmifolia** Lam. (Moraceae). Type host of *T. greeni* and reported from Philippine Islands (Chamberlin 1923, p. 168 ; Kapur 1958, p. 18).
113. **F. wightiana** Wall. (Moraceae). Host of *Laccifer* spp. in Formosa. *L. greeni* specimens from this plant were compared with the Type Specimen by Dr. Chamberlin (Takahashi 1928a, p. 347 ; 1928b, p. 261 ; 1929, pp. 15 & 69 ; 1949, p. 23). Successfully inoculated with lac insect in Taiwan, China (Chung-lo 1957, p. 87 ; Gupta 1962, p. 118 ; and Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 17, mentioned *F. infectoria* Roxb. and *F. lucescens* Blume as synonyms). *Rangeeni* lac was observed on it at Calcutta, India (Mukhopadhyay 1962, p. 329 ; Bhattacharya & Prasad 1964, pp. 702-703).

114. **Filicium decipiens** Thw. (Sapindaceae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413; Chamberlin 1923, p. 106; Kapur 1958, p. 14; Mathur & Singh 1960b, p. 151; Sharapov & Prokopenko 1960, p. 18; Gupta 1962, p. 114). Mukhopadhyay (1962) reports that this plant was recorded earlier as lac-host by Macmillan in 1914 and by Benthall in 1946, as quoted in WEALTH OF INDIA, Vol. 4 (F-G), 1956, pp. 40-41.
115. **Gardenia (Gordonia) floribunda** Wall. (Rubiaceae). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16).
116. **Glycine javanica** Linn. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
117. **Gossypium barbadense** Linn. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
118. **G. insulare** Pulle. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
119. **Grevillea robusta** A. Cunn. (Proteaceae). Host which promotes the maintenance and growth of the lac insect but does not induce secretion of appreciable quantities of resin (Sreenivasaya, 1924, pp. 120, 124 & 125). Recent record of *Rangeeni* lac on it at Ranchi, India (Prasad & Mehra 1967).
120. **Grewia acuminata** Juss. (Tiliaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
121. **G. celtidifolia** Juss. (Tiliaceae). Favoured lac-host species of genus *Grewia* in Yunnan, China (Chung-lo 1957, p. 87; Gupta 1962, p. 120; Roonwal 1962, p. 37). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
122. **G. disperma** Rottl. (= *G. glabra* Bl.) (Tiliaceae). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16, mentioned it as synonym of *G. laevigata* Vahl.). Roonwal & Singh (1958) have listed '*Grewia didyma* or *laevigata*' and Hautefeuille (1924) has mentioned '*G. didyma*'.
123. **Guazuma tomentosa** H.B. & Kunth. (= *G. ulmifolia* Lam.) (Sterculiaceae). Lac insect has been found on it. Parthenogenetic cells were also collected from it. Best tree for pseudo-lac insects. *L. mysorensis* grows well (Mahdihassan 1923, pp. 47, 58, 60 and 66). *Lakshadia communis* is said to thrive sufficiently well on this plant (Chamberlin 1925, p. 38).

124. **Haematoxylon campechianum** Linn. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
125. **Harpullia arborea** (Blanco) Radlk. (Sapindaceae). Host-plant of *Laccifer albizziae* (Kapur 1958, p. 14).
126. **H. cupanioides** Roxb. (Sapindaceae). Host of *T. albizziae* in Ceylon. Yellow colony was also observed (Green 1922, p. 413 ; Chamberlin 1923, p. 166 ; Mathur & Singh 1960c, p. 36 ; and Gupta 1962, pp. 114-115) ; also of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
127. **Helianthus annuus** Linn. (Compositae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
128. **Hemicyclia** sp. (= *Drypetes* sp.) (Euphorbiaceae). According to the material received from Kelawawa, Ceylon, this plant is host of *L. albizziae* (Chamberlin 1923, p. 166).
129. **H. sepiaria** Wight & Arn. [= *Drypetes sepiaria* (W. & A.) Pax & Hoffm.] (Euphorbiaceae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413 ; Chamberlin 1923, p. 166 ; Kapur 1958, p. 14 ; Mathur & Singh 1960c, p. 32 ; Gupta 1962, p. 114).
130. **Heritiera littoralis** (Dryand.) (Sterculiaceae). Host of *L. greeni* in Formosa (Takahashi 1928b, p. 261 ; 1929, pp. 17 & 69).
131. **Hevea brasiliensis** (H.B.K.) Muell.-Arg. (Euphorbiaceae). Attempts were made to propagate *L. javanus* and *L. lacca* on it at Malaya (Miller 1933, pp. 4 & 21 ; 1937, pp. 19 & 24 ; Gupta 1962, p. 115).
132. **Hibiscus mutabilis** Linn. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
133. **H. rosa-sinensis** Linn. (Malvaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
134. **H. syriacus** Linn. (Malvaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 17).
135. **Hovenia dulcis** Thunb. (Rhamnaceae). Host of *L. lacca* in the Oriental region and Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 18 & 30).
136. **Hymenaea courbaril** Linn. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

137. **Jacaranda acutifolia** Humb. & Bonpl. (Bignoniaceae). Syn. *J. mimosifolia* D. Don and *J. ovalifolia* R. Br. Host-plant of *L. communis* and *L. lacca* in Indian region (Kapur 1954, pp. 646-647; 1958, pp. 16 & 19-20; Roonwal & Singh 1958, p. 138; Mathur & Singh 1960c, p. 75).
138. **Juglans regia** Linn. (Juglandaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30). Prof. E. V. Borkhsenius also reported it as host-plant of lac insect in the U.S.S.R., while giving a talk on 17-2-1964 at the Indian Lac Research Institute, Ranchi, on 'Works carried out on lac insect in Soviet Union'.
139. **Juniperus excelsa** Bieb. (Cupressaceae). Host-plant of *Laccifer lacca* in Indian region (Kapur 1958, p. 20, mentioned it as synonym of *J. macropoda* Boiss. which is recorded as host of lac insect also by Roonwal & Singh 1958, p. 138; Mathur & Singh 1960c, p. 82).
140. **Justicia carnea** Nichols. (Acanthaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
141. **Kydia** sp. (Malvaceae). *L. lacca* feeds on it in India (Green 1922, p. 410; Chamberlin 1923, p. 171, misspelt as 'Kejdia'; Mathur & Singh 1960c, p. 87).
142. **Landolphia** sp. (Apocynaceae). Host of *T. albizziae* in Ceylon (Green 1922, p. 413; Kapur 1958, p. 14; Gupta 1962, p. 114).
143. **L. kirikii** Dyer (Apocynaceae). *L. albizziae* feeds on sap of stems and leaves (Mathur & Singh 1960d, p. 11).
144. **Lawsonia inermis** Linn. (Lythraceae). Syn. *L. alba* Lam. Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
145. **Leea aspera** Wall. non Edg. (Vitaceae). One of the major lac-hosts of Assam, India (Krishnaswami & Saikia 1959, p. 297; Krishnaswami, 1960 p. 14).
146. **Leucaena glauca** (Linn.) Benth. [= *L. leucocephala* (Lam.) de Wit.] (Leguminosae). Syn. *Mimosa glauca* L. One of the two hosts proposed by Oken as host of his genus *Laccifer* (Cockerell 1924, p. 47; Chamberlin 1925, p. 33). Host of *L. lacca* in India (Kapur 1958, p. 20).

147. **Limonia acidissima** Linn. [= *Feronia limonia* (Linn.) Swingle] (Rutaceae). Syn. *Feronia elephantum* Correa. Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 16). Lac-host recorded from Punjab, India (Watt 1901, p. 211 ; Roonwal & Singh 1958, p. 136 ; Malhotra 1964, p. 369, synonymy given).
148. **Liquidambar formosana** Hance (Hamamelidaceae). Host of *L. greeni* in Formosa (Takahashi 1929, pp. 18 & 69).
149. **Macaranga megalophylla** Muell. Arg. (Euphorbiaceae). Fairly extensive lac incrustations of *L. javanus* were found and attempts were made to propagate lac on it in Malaya. Its brood was inoculated on other plants (Miller 1933, pp. 5, 15, 18, & 19 ; 1937, pp. 1 & 10 ; Gupta 1962, p. 115).
150. **M. populifolia** Muell. Arg. (Euphorbiaceae). Attempts were made to propagate *L. javanus* on it in Malaya (Miller 1933, p. 18 ; Gupta 1962, p. 115).
151. **Machilus** sp. (= *Persea* sp.) (Lauraceae). Host of *L. greeni* and *Laccifer* sp. in Formosa (Takahashi 1928a, p. 347 ; 1928b, p. 261 ; 1929, pp. 18 & 69).
152. **Madhuca latifolia** (Roxb.) Macb. (= *M. indica* Gmel.) (Sapotaceae). Syn. *Bassia latifolia* (Roxb.). Host of *L. lacca* in the Oriental region. (Sharapov & Prokopenko 1960, p. 20). Major lac-host in the Punjab, India (Anand 1936, p. 9 ; Malhotra 1964, pp. 367-368).
153. **Mallotus cochinchinensis** Lour. (Euphorbiaceae). Attempts were made to propagate *L. javanus* on it in Malaya (Miller 1933, pp. 4, 18, 19, & 21 ; Gupta 1962, p. 115).
154. **Michelia champaca** Linn. (Magnoliaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 17).
155. **Millettia auriculata** Baker ex Brandis (= *M. extensa* Benth. ex Baker) (Leguminosae). Lac encrustation was found on the leaf of this plant at Taimara, Ranchi Forest Division, India (Purkayastha & Krishnaswami 1961, p. 153 ; Mukhopadhyay 1962, p. 329).
156. **Mimosa** sp. (Leguminosae). Host of *T. conchiferata* in Ceylon (Green 1922, p. 408 ; Gupta 1962, p. 114). Also host-plant of *L. chinensis* in Maejo, Chiangmai, in Thailand (based on information provided to junior author by the Department of Agriculture, Thailand).

157. **M. himalayana** Gamble (Leguminosae). Regional host tried for lac cultivation at Mirzapur, India (I.L.R.I. Ann. Rep., 1962-63, p. 18).
158. **Moghania chappar** (Ham. & Bth.) O. Kuntze (Leguminosae). Syn. *Flemingia chappar* Buch.-Ham. Capable of sustaining both *Rangeeni* and *Kusmi* strains of the lac insect (Purkayastha & Prasad 1962, pp. 541-542; Mukhopadhyay 1962, p. 329).
159. **Morus alba** Linn. (Moraceae). Lac insect is reported on it in the Oriental region and in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 17 & 30).
160. **M. macassariensis?** (Moraceae). Lac has been reared on it at District Rangpur, India (Buchanan-Hamilton 1825, p. 50; Watt 1901, p. 218). Director, Royal Botanic Gardens, Kew, states about the plant species: 'This epithet not traced in *Morus*. There is, however, an *Ampalis madagascariensis* Boj. (Syn. *Morus nitida* Willem.) (family Moraceae), which might have been meant'.
161. **M. nigra** Linn. (Moraceae). Lac insect is reported on it in the Oriental region and from Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, pp. 17 & 30).
162. **Nephelium lappaceum** Linn. (Sapindaceae). Food plant of the lac insect in Siam and Formosa (Takahashi 1949, p. 25).
163. **Ougeinia oojeinensis** (Roxb.) Hochreut (Leguminosae). This is the changed name for *Dalbergia oojeinensis* Roxb. and *O. dalbergioides* Benth. (Raizada 1958, p. 501; Prasad 1965, p. 298) and is a successful host of lac insect in India (Roonwal *et al.* 1958, pp. 27, & 76-77; Mathur & Singh 1960d, p. 140).
164. **Palaquium formosanum** Hayata (Sapotaceae). Host of *L. greeni* in Formosa (Takahashi 1928b, p. 261; 1929, pp. 22 & 69).
165. **Paliurus ramosissimus** Poir. (Rhamnaceae). Food plant of the lac insect in Siam and Formosa (Takahashi 1949, pp. 24 & 26).
166. **P. spina-christi** Mill. (Rhamnaceae). Lac-host in Georgia, U.S.S.R. Experiments of lac culture are running since 1959 on this plant in Russia (Sharapov & Prokopenko 1960, p. 30).
167. **Parkia biglandulosa** W. & A. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).

168. **Peltophorum inerme** (Roxb.) Naves [= *P. pterocarpum* (DC.) Backer ex K. Heyne] (Leguminosae). Syn. *P. ferrugineum* Benth. Host-plant of *L. communis* in India (Kapur 1958, pp. 16-17). Host-plant of *L. lacca* (Kapur 1954, p. 646 ; Mathur & Singh 1960e, p. 10 ; Srivastava, Rao, & Varshney 1964, p. 104).
169. **Pentace burmanica** Kurz. (Tiliaceae). Host-plant of *L. chinensis* in Thailand (based on information provided to junior author by the Royal Forest Department, Thailand).
170. **Persea gratissima** Gaertn. (Lauraceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16).
171. **Phyllanthus emblica** Linn. (= *Embllica officinalis* Gaertn.). (Euphorbiaceae). Syn. *Ph. mairei* Levielle. Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
172. **Pithecellobium** sp. (Leguminosae). *L. lacca* feeds on sap of twigs, branches, and stem (Mathur & Singh 1960e, p. 41).
173. **Platanus orientalis** Linn. (Platanaceae). Host of *L. greeni* in Formosa (Takahashi 1929, pp. 23 & 70).
174. **Polymnia grandis** Hort. (Compositae). Host-plant of *L. communis* in India (Kapur 1958, p. 16, mentioned it as synonym of *Montanoa bipinnatifida* C. Koch).
175. **Premna tomentosa** Willd. (Verbenaceae). Tree observed with lac in India (De 1933, p. 293 ; Tschirch & Stock 1936, p. 1451, Fig. 435).
176. **Prosopis juliflora** DC. (Leguminosae). Host of Sind lac insect, *L. sindica*, in W. Pakistan ; a Brazilian plant (Mahdihassan 1957, p. 114).
177. **Pterocarpus draco** Linn. (Leguminosae). Chinese drug (mistaken for lac) is furnished by it. (Mahdihassan 1954, p. 319). We think it is a doubtful record of lac-host.
178. **P. indicus** Willd. (Leguminosae). Host-plant of *L. communis* in India (Kapur 1958, p. 17).
179. **Pterogaria** ? sp. (Juglandaceae ?). Host-plant of *Coccus lacca* in Indo-China, reported by Crevost as 'Co-Xom' (Haute-feuille 1924, p. 15). Director, Royal Botanic Gardens, Kew, informs that it is probably *Pterocarya* Kunth (family Juglandaceae).

180. **Pterospermum acerifolium** Willd. (Sterculiaceae). *L. albizziae* feeds on sap of twigs, branches, and stems (Mathur & Singh 1960e, p. 83).
181. **P. diversifolium** Blume (Sterculiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
182. **Putranjiva roxburghii** Wall. (Euphorbiaceae). Host-plant of *L. communis* in India (Kapur 1958, p. 16). *L. lacca* feeds on it (Mathur & Singh 1960e, p. 86). Also reported as host of *L. chinensis* by the Royal Forest Department, Thailand to junior author.
183. **Pyrus malus** Linn. (Rosaceae). Host on which it is reported that lac insect continues for three generations (Sreenivasaya 1924, pp. 120, 124, & 125).
184. **Quisqualis** sp. (Combretaceae). Type host of *Laccifer rangoonensis*, reported from Burma (Chamberlin 1925, p. 35; Kapur 1958, p. 23).
185. **Rhamnus alaternus** Linn. (Rhamnaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
186. **Rhodomyrtus tomentosa** Wight (Myrtaceae). Host of *L. greeni* in Formosa. (Takahashi 1929, pp. 24 & 70).
187. **Rhynchosia cana** DC. (Leguminosae). Three inches encrustation was observed on this herb-like plant (Mahdihassan 1923, p. 64). Host-plant of *L. mysorensis* in India (Kapur 1958, p. 22).
188. **R. rufescens** DC. (Leguminosae). Host-plant of *L. mysorensis* reported from India (Kapur 1958, p. 22).
189. **Robinia pseudoacacia** Linn. (Leguminosae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
190. **Salix** sp. (Salicaceae). The senior author at Indian Lac Research Institute, Ranchi, inoculated it with lac insects, *Katki* 1965 life-cycle. Fine settlement of larvae and early development were observed. This is the first record of rearing lac insect on it or on any member of the Salicaceae.
191. **Schleichera** sp. (Sapindaceae). *L. lacca* (Kerr) feeds on sap of twigs, branches, and stems (Mathur & Singh 1961a, p. 31).
192. **Semecarpus anacardium** Linn. f. (Anacardiaceae). Lac infection was observed on this plant at Taimara, Ranchi Forest Division,

India (Purkayastha & Krishnaswami 1961, p. 152 ; Mukhopadhyay 1962, p. 328).

193. **Shorea** sp. (Dipterocarpaceae). *L. lacca* (Kerr) feeds on sap of twigs, branches, and stems (Mathur & Singh 1961a, p. 54).
194. **S. cochinchinensis** Pierre (Dipterocarpaceae). Host of *L. chinensis* and *L. lacca* in the Oriental region (Kapur 1958, p. 15 ; Sharapov & Prokopenko 1960, p. 19, respectively).
195. **Spatholobus roxburghii** Benth. (Leguminosae). Lac-host in Burma [Gupta 1962, p. 135, written as '*Spatholobus (Butea) roxburghii* (*Butea superba*) or (creeper *palas*)', burmese name of plant mentioned as 'Pauk-nwe']. Roonwal *et al.* (1958) reported it as synonym of *Butea parviflora* Roxb., a rare lac-host at Travancore, India. Director, Royal Botanic Gardens, Kew, provides the following nomenclative position: '*Spatholobus roxburghii* Benth. (Syns. *Butea parviflora* Roxb. and *B. sericophylla* Wall.)—family Leguminosae'.
196. **Sterculia pexa** Pierre (Sterculiaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 20).
197. **Tamarindus** sp. (Leguminosae). *L. lacca* feeds on it (Mathur & Singh 1961b, p. 5).
198. **Tanarius major** ? (= *Macaranga* sp.) (Euphorbiaceae). Lakka wood of China. Source of the red dye-stuff, namely stick-lac (Mahdihassan 1954, p. 321). Present authors think it a doubtful record of a lac-host. Regarding this plant's name Director, Royal Botanic Gardens, Kew, states: 'This epithet not traced in *Tanarius*, or *Macaranga*, under which *Tanarius* is included. (family Euphorbiaceae)'.
199. **Terminalia** sp. (Combretaceae). Food-plant of the lac insect in Siam and Formosa (Takahashi 1949, p. 24).
200. **T. catappa** Linn. (Combretaceae). Host of *L. greeni* in Formosa (Takahashi 1930, p.41).
201. **Theobroma cacao** Linn. (Sterculiaceae). Host of *T. albizziae* in Ceylon etc. (Green 1922, p. 413 ; Kapur 1958, p. 14 ; Mathur & Singh 1961b, p. 48 ; Sharapov & Prokopenko 1960, p. 20 ; Gupta 1962, p. 114).
202. **Tilia** sp. (Tiliaceae). Prof. E. V. Borkhsenius reported it as host-plant of lac in U.S.S.R., while giving a talk on 17-2-1964 at the Indian Lac Research Institute, Ranchi, on 'Works carried out on lac insect in the Soviet Union'.

203. **T. caucasica** Rupr. (Tiliaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
204. **T. tomentosa** Moench. (Tiliaceae). Lac-host in Georgia, U.S.S.R. (Sharapov & Prokopenko 1960, p. 30).
205. **Varinga latifolia** ? (Moraceae). Lac has been reared on it in District Rangpur, India : plant colloquially known as 'Dhop' (Buchanan-Hamilton 1825, p.50 ; Watt 1901, p. 218, suspects it as a species of *Ficus*, probably *F. cunia*). Regarding the name of this plant, Director, Royal Botanic Gardens, Kew, states : ' *Varinga* had only one species published in it—*V. repens* Raf. This is a synonym of *Ficus pumila* L. (family Moraceae). There is, however, a *Vangueria latifolia* Sond. (family Rubiaceae) which might have been meant.'
206. **Vatica chinensis** Linn. (= *Shorea roxburghii* G. Don. (Dipterocarpaceae). Lac insect feeds on it in south India (Buchanan-Hamilton 1800, p. 238 ; Watt 1901, p. 265).
207. **Vitis vinifera** Linn. (Vitaceae). Host of *Laccifer communis* in India (Mahdihassan 1936 ; Kapur 1958, p. 16). Also of *Laccifer lacca*, found at Ranchi, India (Mehra 1955, p. 264 ; Mukhopadhyay 1962, p. 328).
208. **Wrightia tinctoria** R. Br. (Apocynaceae). Host of *L. communis* in India (Kapur 1958, p. 16).
209. **Xylia** sp. (Leguminosae). *L. lacca* feeds on sap of twigs and branches (Mathur & Singh 1961b, p. 99).
210. **X. kerrii** Craib & Hutch. (Leguminosae). Lac-host in Thailand (Samapudhhi 1957, p. 30). Host of *L. chinensis* in India, Indo-China, and Siam (Kapur 1958, p. 15).
211. **Zizyphus** sp. (Rhamnaceae). *L. lacca* feeds on sap of twigs and branches (Mathur & Singh 1961b, p. 111).
212. **Z. lotus** Lam. (Rhamnaceae). Lac and gum of this plant are alike to Arabs (Mahdihassan 1954, p. 322, cited Abu Mansur). In our view it is doubtful whether this plant is a lac-host.
213. **Zizyphus mauratiana** Lam. (Rhamnaceae). This is the changed specific name for *Z. jujuba* Lam. non Mill. (*Vide* Raizada 1958, p. 515), which is one of the most important and common host of lac insect (Watt 1901, p. 213 ; Glover 1937, p. 137 ; Srinivasan 1956, p. 180 ; Roonwal *et al.* 1958, pp. 17, 19, 27 & 65). But Raizada (1966) uses *Z. mauritiana* again while referring to var. *fruticosa*.

214. *Z. nigra* ? (Rhamnaceae). Host-plant of *T. lacca* at Cambodia. One of the hosts tried with success there (de Flacourt 1927, p. 125 ; Gupta 1962, p. 125). Regarding the name of this plant, Director, Royal Botanic Gardens, Kew, writes: ' this epithet not traced in *Ziziphus* (family Rhamnaceae) '.
- 215 *Z. nudinervis* Rehd. (Rhamnaceae). Host of *L. lacca* in the Oriental region (Sharapov & Prokopenko 1960, p. 19).
- 216 *Z. spini-christi* Willd. (Rhamnaceae). Host of *L. lacca* recorded from the Oriental region (Sharapov & Prokopenko 1960, p. 19).
217. *Z. vulgaris* Lam. (= *Z. jujuba* Mill.) (Rhamnaceae). Important lac-host at Ellichpur Division and rare host at Wun Division in Berar Circle, India (Stebbing 1910, p. 73).

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The Point Calimere Sanctuary, Madras State—May 1967

BY

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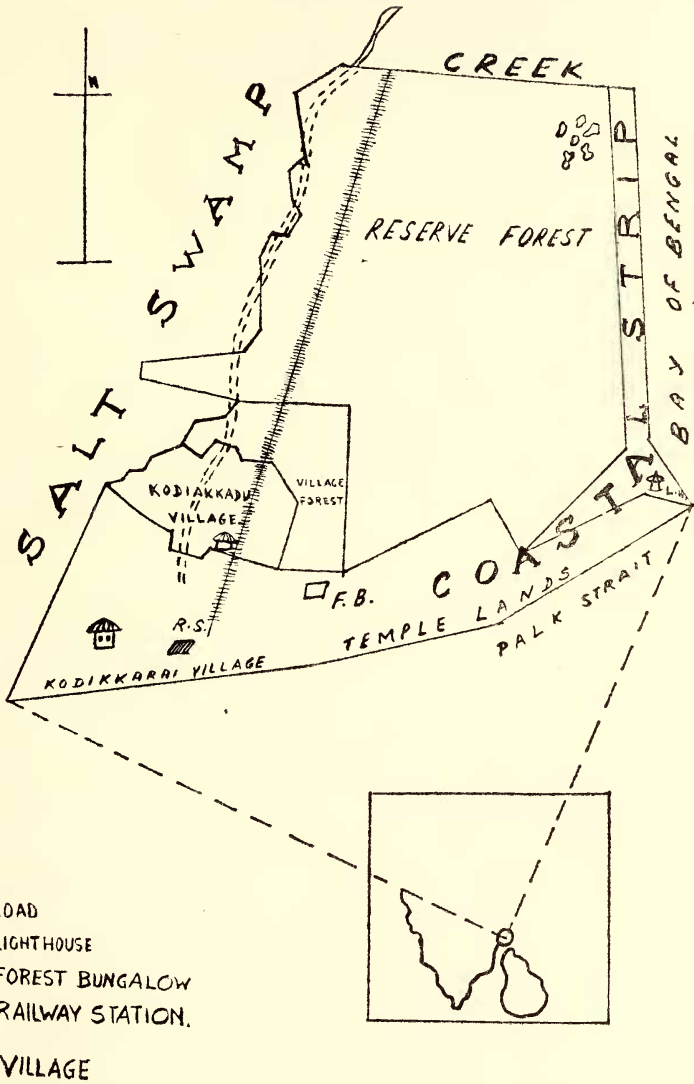
Bombay Natural History Society

(*With a map*)

INTRODUCTION

The Blackbuck [*Antelope cervicapra* (Linn.)] is unique in several respects. It is an exclusively Indian animal, the only representative of its genus in India, one of the fastest animals in the world, and one of the very few truly plains-dwelling animals of the Indian fauna. The latter habit is apparently the main cause of the alarming and continuing decline in its population, as there is now hardly any open land in the country which is not under some type of cultivation. The large herds which were found in the Gangetic plain and in some parts of the Deccan at the turn of the century have dwindled to a few hundreds in isolated pockets. A recent assessment of their population based on available information (Schaller 1967) leaves no room for doubt that within the next few years the blackbuck will cease to exist except in well-maintained sanctuaries. It is, therefore, very necessary that precise information on the status of this species in different parts of the country be collected as early as possible. It was in this context that a census of the blackbuck in the Point Calimere area was considered. This area is believed to hold the largest number of blackbuck in the south of India. The State Wild Life Officer, Mr. M. A. Badshah, on being approached, offered all facilities and I spent five days in May in the sanctuary observing and censusing blackbuck.

Point Calimere (10° 18' N., 79° 51' E.), the *Calligicum* of Ptolemy, is a low promontory on the Coramandel coast, in the Tirutturaipundi Taluk of Thanjavur Dt., Madras State. The only human habitations in the area are Kodikkarai village on the seashore and Kodiakkadu village, further inland. Extensive salt swamps, the winter resort of countless migratory waterfowl, lie to the west of the villages. About three miles east of Kodikkarai village and approximately at the head



Map of Point Calimere Sanctuary

of the promontory, a lighthouse has been in existence since 1902. A branch line of the Southern Railway from Tirutturaipundi terminates at the station of Point Calimere about a quarter mile from the shore and between the villages of Kodikkarai and Kodiakkadu. This line was laid in 1936, apparently to foster trade with Ceylon, a mere forty miles away across the Palk Strait, but now appears to cater mainly to pilgrims who come to pray at the temple at Kodiakkadu and to bathe in the sea.

We reached Calimere on 22 May and were met by Mr. V. Subbiah, the Range Officer in charge of the sanctuary. The Forest Bungalow situated on the SW. corner of the sanctuary, about 200 yards from the Railway Station, offers an excellent view of the sea and parts of the sanctuary. The sanctuary when fully constituted will have an area of c. 6,000 acres or 10 sq. miles of dry thorn scrub jungle and open sea coast, consisting of Kodiakkadu Reserve Forest, the Village Forest and Coastal Strip bounded on the east and south by the sea, on the north by a creek connecting the salt swamps on the west to the sea on the east, and on the west by the road running to the interior from the villages. A tongue of land connects the sanctuary to the salt swamps (Map).

HABITAT

Kodiakkadu Reserve Forest

The Reserve forms the major part of the sanctuary, approximately 4,250 acres of scrub jungle with thorn and other xerophytic vegetation predominating. The forest is not continuous but is intersected by numerous tidal inlets and creeks of varying length and width which were bone-dry in May. Dense thorn-scrub forest of an average 10 to 12 feet height covers the raised land in between the creeks. Dominant trees and shrubs are *Dichrostachys cinerea* Wt. & Ar., *Manilkara hexandra* (Roxb.) Dub., *Memecylon umbellatum* Burm., *Carissa carandas* L.; *Excoecaria aqallocha* L. and other species of Euphorbiaceae; *Cassia fistula* (L.), *Cassia auriculata* L.; *Vitis quadrangularis* Wall., *Capparis zeylanica* (L.) and other creepers are found in profusion and in some parts of the forest, smothering the shrubs and trees and, in May when most of the creepers are dry giving a hoary appearance to parts of the forest. Except in some glades, the result of clear-felling of earlier Casuarina plantations, there was no grass within the forest.

Village Forest

This is contiguous with the Reserve and has an area of approximately 547 acres. Unlike the Reserve, which is not worked by the Forest Department, there is considerable felling, accelerated I believe

by the imminent handing over of the forest to the Forest Department. Secondary growth is very evident and thick in some areas.

Coastal Strip

The sea-coast on the south and east of the Reserve is approximately half-a-mile in width and has an area of 812 acres on the south and 370 acres on the east. The southern strip owned by the temple at Kodiak-kadu village is being taken over by the Forest Department. The coastal strip is a more or less flat plain with occasional isolated clumps of pandanus and thorn scrub. In the vicinity of the lighthouse there are small elevated areas covered with larger shrubs and a small stand of *Casuarina* forms a windbreak to the west of the lighthouse. Most of the sea-coast is under grass, and grass-like plants. The predominating species are : *Aeluropus lagopoides* (L.) Trin. (local name *Uppukordai*) a perennial grass of coastal sands very variable in habit and foliage and the sedge *Cyperus arenarius* Retz., a species of the sea-coast from Sind to Ceylon. In shallow, moist depressions the glaucous green, fleshy-leaved, *Suaeda maritima* Dum. occurred in pure stands, and appeared untouched by any animal. Nearer to the sea are to be seen occasional clumps of *Spinifax* sp. Both *A. lagopoides* and *C. arenarius* were very close-cropped and appeared overgrazed.

Potable water in the sanctuary was available only at a water hole dug by the Forest Department in the Reserve Forest. I was informed that chital, when hard pressed, drink at night from the temple tank.

Climate

Temperature data for Calimere are not available. The nearest town Nagapattinam, 35 miles to the north along the coast, has an annual mean temperature of 80°F. and, Calimere probably has a similar climate, the temperature rarely falling below 65°F. and rising above 105°F.

The area gets most of its rain from the north-east monsoon, but is also within the range of the south-west monsoon and the district in some years receives more rain from it than from the former. However, most of the rainfall is between the months of October and December. The town of Nagapattinam receives 54 in. though the average for the district is 44 in. Cyclonic storms of high intensity often occur during the north-east monsoon and in 1952 and 1955 caused extensive damage along the coast.

CENSUS

Most of the blackbuck were said to live on the coastal strip of the sanctuary and only a few within the Reserve. Walks through the major part of the sanctuary confirmed this fact and I felt that fairly accurate

estimates could be obtained in the open coastal plains as well as within the forest.

On 25 May, with the assistance of Mr. V. Subbiah, I censused the blackbuck living outside the Reserve and Village forests on the coastal strips of the sanctuary. The distance between the sea and the edge of the forest being nowhere over half-a-mile we were able to cover the whole width of the strip walking abreast at the centre of the strip and when necessary varying the distance between us in relation to the width of the strip. While Mr. Subbiah counted the animals towards the sea, I concentrated on those towards the forest. The animals in between us moved into one or the other counting area as we moved forward. We each had a forest guard with us to inform us if any animal or a herd moved from one counting area into the other. There was no movement from the depth of one counting sector forward into the next, mainly due to the smallness of our party, the slowness of our approach, and the fact that the animals showed little fear of man. Commencing our count from the north-west corner of the sanctuary we walked east along the side of the creek, glassing the inlets from the creek into the sanctuary till we reached the strip of shore on the east of the sanctuary. We then turned south and walked towards the lighthouse, turning west at the lighthouse for the bungalow. The creek shore had no buck and adjoining inlets very few. The east strip had a fairly good number, and the number increased as we approached the lighthouse. The area in the vicinity of the lighthouse and to its west near the casuarina and pandanus held the largest number, which gradually fell off as we approached the bungalow. No blackbuck were seen within about 300 yards of the bungalow.

The next day we walked through most of the forested area visiting areas known to hold blackbuck or likely to have them. The majority of the tidal inlets, creeks, and other open areas within the forest were visited. The blackbuck were more in areas towards the sea than within the forest. We did not see any inside the forests except for a herd near the waterhole in the north-west portion of the Reserve. There were also none in the small area of the sanctuary abutting the great salt swamp in the west. We covered over 85% of the sanctuary during the two days of censusing and the estimates we obtained can be considered as reasonably accurate for the foreshore area which is apparently the preferred habitat. The estimate for the forested area may also express the true position, though the chances of herds or single animals being missed are more in this area.

Results

The actual counts as well as my estimates of the total in the two areas of the sanctuary are given in the Table below.

TABLE

	No. of herds	Sub-adult		Fawn	Un-sexed	Total	Estimated Total		
		♂	♀						
Foreshore	41	128	24	219	30	23	125	549	600
Forest	6	25	4	66	9	2	4	110	150
Total	47	153	28	285	39	25	129	659	750

I do not think the number of blackbuck in the sanctuary exceeds 800. Age composition data of the animals was also gathered. While it was not difficult to distinguish young males with budding or very small horns, the females were a problem. As in some peripheral herds and others partially screened by vegetation or the lie of the land the young males with budding or small horns could not be satisfactorily separated from the females, all fawn-coloured animals whose sex organs were not visible were noted as not sexed.

Among the 659 animals that were counted 154 (including 25 fawns) or 23% were not sexed. One hundred and eighty-one or 36% of the sexed animals were males, and 153 or 30% were adult. One out of every six was a sub-adult male. Stracey (1960) states that when he visited the sanctuary in 1959 'the darker-coloured males are extraordinarily few and most of the males, which must have constituted about half the numbers, were young buck.' However, I have included among adults, in addition to black, dark brown animals with full-grown horns and three years plus in age, and it is not clear whether 'young buck' of Stracey includes these. Three hundred and twenty-four or 64% were females and 285 or 56% were adults. One out of every 7 female was a sub-adult. The sub-adult animals form 13% of the sexed population and 17% when the unsexed fawns are included in the total. One out of 11 adult females was accompanied by a fawn. But it must be noted that my remarks on the number of sub-adults in relation to adults refer *only* to the sexed population and the unsexed animals being mainly sub-adults, their number in the population may not be so low as the percentages indicate.

The sex ratio is 54 males for 100 adult females, approximately 1 : 2 and 71 sub-adult males for 100 sub-adult females, approximately 1 : 1.5. One of the causes for the reduction in the number of adult males is perhaps poaching.

It is evident from the figures that the majority of the blackbuck live in the foreshore area of the sanctuary. During my visit most of the animals were in herds ranging in size from 3 to 47 but mainly of about a dozen animals. Herds with a single adult male predominated but the largest herd had seven. The foreshore appeared to have been territorially divided among the several herds living in them. In the periphery of the most favoured areas numerous unattached males were seen. Marker defecation sites were common and consisted of pits about a foot in diameter and nearly six inches in depth formed by the pawing of the animal. Dung pellets lay inside and around the pit. Blackbuck in north and central India have two definite peaks in the rutting season, one in April and another from mid-August to mid-October (Schaller 1967), when males establish territories and harems. The habits in south India appear similar. During May the animals were still in breeding herds. No copulation was seen but does were being chased. Herd territories appeared stabilised. My notes record only one fight, on 23 May: 'the herd master-buck and challenger walk parallel to each other; herd buck walking stiff legged, with tail raised; both stop and herd buck presents side to challenger which turns; animals facing in opposite directions; turn and face each other, muzzles nearly touch; challenger lowers head, threatens; herd buck backs; challenger presents side; both bring up head, muzzles nearly touch, lower head, engage; herd buck backing; disengage; raise head, muzzles nearly touch; re-engage'. I was unfortunately seen by the animals at this time and they broke off the fight, the herd buck returning to its harem of 4 females and a sub-adult and the challenger running back the way it had come. I was informed by Forest Department personnel that from November onwards, during the rains, the animals gather in large mixed herds in the coastal area and almost all the animals in the sanctuary are then in that area. This agrees with the formation of large mixed herds during the non-breeding season in north India. The movement of the animals, which normally live within the forested areas, to the coastal strip is probably due to the creeks and inlets filling up with water.

The herds I watched spent the day in feeding and desultory movement in a limited area. Feeding was not restricted to a particular period of the day but was more evident in the morning and the evening. During the hottest part of the day they more often stood quietly or lay down in the hot sun. Cover was not usually used even when available, but I twice saw animals standing in the shade of thorn scrub. The food appeared to be mainly the grass *Aeluropus lagopoides* and the sedge *Cyperus arenarius*. I did not see them browsing. There is no potable water in the coastal area and no movement was seen towards the water hole in the Reserve. Unless they drink sea-water the animals must be spending considerable periods without water. No sign of sickness was seen and most of the

animals were in good condition in spite of the forage being sparse. The only evidence of injury we saw was of a buck with a single horn and another limping with its left foreleg.

There are no large predators at Calimere, the jackal being the largest. Jackals and wild pigs are however said to kill and eat a number of newly-born fawns. Jackals are certainly capable of killing adults if so inclined, as indicated by the recorded instance of a pair of jackals killing blackbuck in the Punjab (Hamber 1924). The only other natural control is said to be 'the periodical cyclones and floods which are stated to levy a heavy toll when they do occur', (Stracey 1960). No sign of dead animals, bones, or horns were seen and the Forest Department personnel also have no records of these.

OTHER ANIMALS

Chital

Chital (*Axis axis*) are said to be plentiful. I saw only five, a female at the edge of the forest at the coastal strip, a magnificent stag in the Kodiakkadu Reserve to the north of the village forest, and a stag and two hinds in the village forest close to the road on the west of the sanctuary. I twice heard the breeding call early in the morning. Both the stags I saw were in hard horn, dark in body colour, and had swollen necks. We also saw a bush in the reserve which had been 'thrashed'. Chital are said to favour the village forest, behaviour that causes concern to the forest officials as the deer can be easily poached in this area. I believe the preference for the village forest is due to the large amount of browse available from the fairly thick secondary growth and the nearness of the two water sources in the sanctuary, the temple tank and the water hole in the reserve. I was concentrating mainly on the blackbuck, and the habitat difference of the two species at Calimere and the density of the scrub suggest that I may have missed most of the chital in the area. I was, however, able to cover a major portion of the forested area and did not see signs that chital occurred in appreciable numbers. I do not believe that there are more than fifty to a hundred chital in the sanctuary.

Wild Pig

Wild pigs are said to be very numerous and local villagers complain that they are unable to plant any root crop or vegetable without having them destroyed by pigs. I saw a sounder of five pigs, inside the Reserve and a solitary animal at the edge of a tidal inlet in the forest. During the census another came out of the forest at a steady trot, the blackbuck moving out of its way, and receiving our wind as it neared the sea, did a U-turn and returned to the forest at the same steady trot. I was struck by the small size of the animals in comparison with the wild boar seen else-

where in the country, and am uncertain whether the pigs in Calimere are wild or feral. The grasslands of the sanctuary are disfigured by patches ploughed up by pigs in search of the rhizome of *Cyperus arenarius*. I am unable to express an opinion on the number of pigs in the sanctuary.

Miscellaneous

On two days we saw a pair of jackals, possibly the same pair, near grazing herds of blackbuck. The antelope did not appear to be unduly concerned about their presence though they kept a distance between them. Jackals apparently move around during the day contrary to their behaviour elsewhere. Stracey (*op. cit.*) also mentions seeing two jackals during his visit. A mongoose was seen in the forest near the foreshore, and I understand that the Hare (*Lepus nigricollis*) is not uncommon. A few small troops of Bonnet Monkeys [*Macaca radiata* (Geoffroy)] occur in the reserve, all, I am told, expatriates from nearby villages and towns.

Birds

Point Calimere, particularly the vast Vedaranyam Salt Swamp to the south-west, 30 miles in length and 4 to 5 miles in width, harbours large numbers of migratory waders and also flamingos in thousands during the winter months (Sálim Ali 1963). At the time of my visit a few Turnstones (*Arenaria interpres*) in breeding plumage were still in the area. I also saw a small flock of about twenty flamingos feeding in the creek to the north of the Sanctuary. The Grey Partridge [*Francolinus pondicerianus* (Gmelin)] was quite common, a pair or two being usually seen in the vicinity of the bungalow. The call was heard frequently.

CONSERVATION PROBLEMS

Domestic Livestock

During the year 1966-67 the Forest Department issued grazing permits for 836 cattle, 57 buffaloes, 20 horses, and 405 sheep, a total permitted domestic stock of 1318 animals. The sanctuary had in May very few cattle, sheep and buffaloes which are perhaps grazed only during the period of optimum conditions in the rainy season. Small herds (5 to 6 animals) of semi-wild ponies wandered around the grasslands. These are captured only when required by the owners and at other times allowed to roam freely and breed in the sanctuary. In the east foreshore I saw the dry carcass of a cow and domestic stock remains a constant source of danger through disease to the wild animals.

Poaching and other Illegal Activities

Poaching apparently is being brought under control. Poaching, as elsewhere in the country, seems to be largely by officials with weapons. Recent cases were against a village official's son and a police constable for

shooting blackbuck. Most of the cases filed appear to be against women firewood-gatherers who go into the forest to collect windfalls and also cut the vegetation when opportunities occur.

Administration

Madras is one of the few States in the country with a separate wild life unit in the Forest Department. The Wild Life Preservation Officer has a staff deputed from the regular forest roster for wild life duty. The Point Calimere Sanctuary is managed by a Range Officer, assisted by a Forester and a Forest Guard. I think the staff is inadequate. Like others of the wild life unit I had met elsewhere in the State, I found Mr. Subbiah keen and enthusiastic and, with some more specialised training, he should benefit the sanctuary considerably.

COMMENTS ON THE POTENTIALS OF THE SANCTUARY

Blackbuck

The large number of blackbuck in the sanctuary, unusual in the present-day status of the species in India, will continue to increase in importance as conditions deteriorate elsewhere. It is therefore necessary that a continuous effort be made to acquire information on the animals in the sanctuary. The absence of a natural check in the form of large predators suggests that the population may reach a stage when lack of food and diseases resulting from debilitation would either result in their number being drastically reduced or the species being wiped out. Evidence has to be obtained whether the present population has exceeded the carrying capacity of the sanctuary and whether the loss of young through jackals and pigs is sufficient to keep the population within carrying capacity. By periodical accurate estimation of age composition of the population through census, the annual recruitment to the population could be determined. The grazing lands of the sanctuary, excluding the forest, are approximately 3,000 acres in area and sustain a population of approximately 2,500, or very nearly an animal to an acre, of herbivores of varying intake capacity. Admittedly, this large population uses the grazing lands only at optimum conditions but the total effect is definitely not to the advantage of the antelope, the deer, and the sanctuary. The effect of wild pigs is also largely destructive as they feed on the rhizome of *C. arenarius*. Range management problems like these require extended periods of field study for answers to the several questions that arise.

Birds

The migrant waders and the enormous flocks of flamingos that are to be seen in the sanctuary are not only an outstanding attraction to

visitors, particularly ornithologists, but also offer excellent opportunities for the study of bird migration. A trial ringing in 1962 resulted in the ringing of 111 birds of 9 species. Among the 57 Marsh Sandpipers (*Tringa stagnatilis*) ringed, two were recovered in Russia. It is hoped that the Government of Madras will agree to the Society's proposal to have a bird-ringing station in the sanctuary.

VISITOR FACILITIES

The forest bungalow at the sanctuary has two suites, accommodation that is quite inadequate if the potential of the sanctuary as a tourist attraction is to be realised. There is no catering and provisions have to be brought in from the town of Vedaranyam six miles to the north. It is necessary that first class hotel accommodation be constructed for foreign as well as Indian tourists.

The Transport facilities are also equally inadequate but can be improved if the Railways are persuaded to attach first class accommodation to their trains during the season from October to March. The nearest airport, is Tiruchirapalli, nearly 100 miles away. However, if a route of the excellent Express Bus service of the State Transport is arranged between Tiruchirapalli airport and Calimere, co-ordinated with the flight timings of the airlines, the sanctuary would benefit.

If these facilities can be arranged and properly publicised the sanctuary should become popular as a tourist attraction.

THE SANCTUARY IN THE HUMAN ECONOMICS OF THE AREA

One of the main reasons for the failure of sanctuaries in India to attain expected standards in the protection of species in them is the hostility of the human population in their surroundings who are denied, at least officially, the economic benefits of the forest produce. The income derived from the sanctuary is also siphoned off into the general revenues and does not benefit the local people. It is time to have a re-thinking on sanctuary management so that the local people are offered a stake in the benefits derived from a well-managed sanctuary. Several sanctuaries in Africa have greatly benefited by having the local population interested in their management.

Of the two villages at Point Calimere, Kodikkarai subsists mainly on fishing and Kodiakkadu probably on grazing and employment elsewhere. Apart from the grazing, collection of firewood appears to be the main benefit from the forest to the villagers, situated as they are in an area where fuel for domestic use is not available except in the sanctuary. From the number of cases of illegal firewood collection, most of the conflict with the authorities appears to arise from this source.